

TRC Reference Number: 28367-0010-00000

April 29, 2004

Mr. Alan Peterson
US EPA Region 1
11 Technology Drive
North Chelmsford, MA 01863-2431

Subject: Brownfields Program Quality Assurance Project Plan (Revision 0)
Former FlynnTan Site, 70-92 Boston Street and
61 Ward Street Site
Salem, Massachusetts

Dear Alan:

On behalf of the City of Salem, TRC Environmental Corporation is pleased to submit this Quality Assurance Project Plan for the above-referenced properties for your review and approval.

If you have any questions, please contact either of the undersigned at 978-970-5600.

Sincerely,

Amy Stattel
Project Engineer

Paul Arnold
Project Manager

Enclosure

cc: Kate Gormly, City of Salem
Joonu Andrews, EPA
TRC Project File

**Brownfields Program Quality Assurance Project Plan
City of Salem**

**Former FlynnTan Manufacturing Company Site
70-92 Boston Street**

and

**61 Ward Street Site
Salem, Massachusetts**

April 2004

Prepared By:

TRC Environmental Corporation
Boott Mills South
Foot of John Street
Lowell, MA 01852
(978) 970-5600

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Attachment B Laboratory Quality Assurance Manual

1.0 APPENDIX A

1.1 Title and Approval Page

City of Salem Quality Assurance Project Plan
Document Title

Amy Stattel
TRC Environmental Corporation
Prepared by

04/26/04
Day/Month/Year

Boott Mills South, Foot of John Street, Lowell, MA 01852
Phone: (978) 970-5600

Project Manager: _____
Signature

Paul Arnold
Printed Name/Date

Project QA Officer: _____
Signature

Elizabeth Denly
Printed Name/Date

U.S. EPA Project Manager Approval: _____
Signature

Joonu Andrews
Printed Name/Date

2.0 APPENDIX B

2.1 Project Organization and Responsibility

The following chart presents the organizational structure for this project.

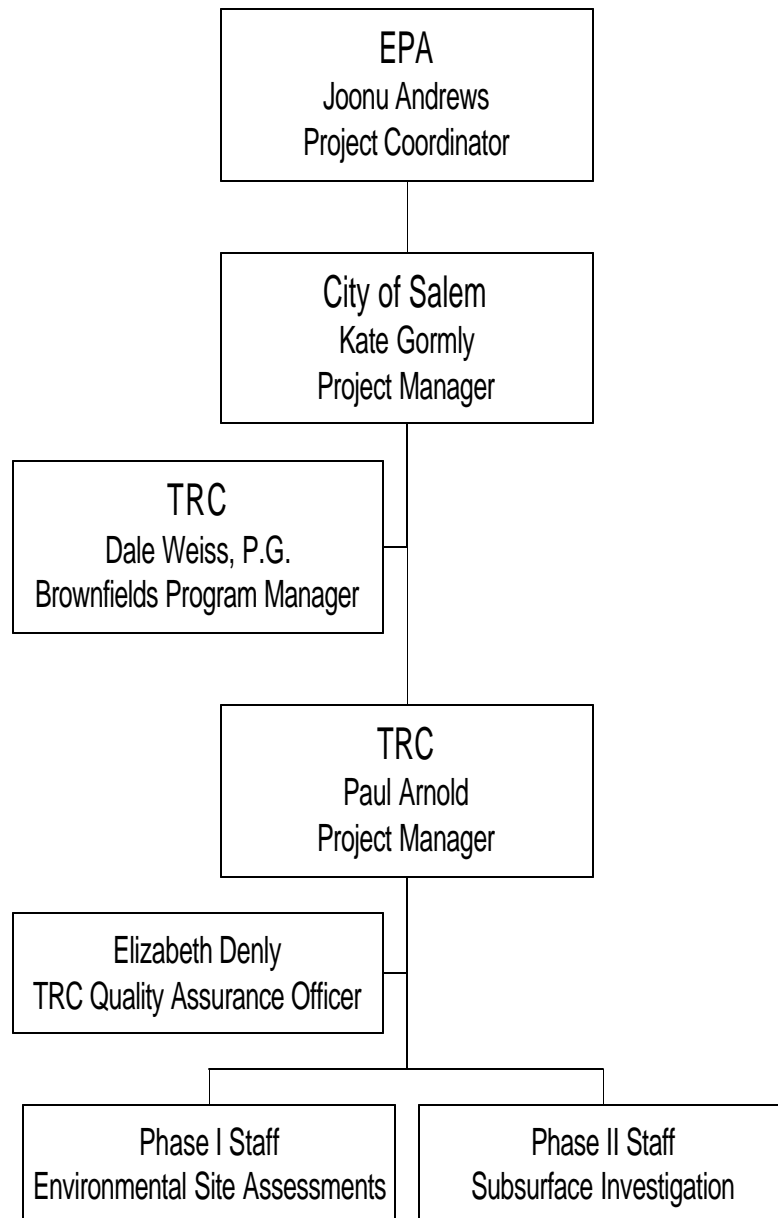
EPA Project Coordinator: Joonu Andrews has been assigned to oversee the project for the U.S. Environmental Protection Agency (EPA). Ms. Andrews will determine whether activities proposed by the City of Salem are within the scope of the City's Grant Agreement with the EPA.

City of Salem Project Manager: Kate Gormly will direct all aspects of the project for the City of Salem. Ms. Gormly will coordinate all contractor activities and provide managerial support during the field investigation, and is ultimately responsible for successful project completion. Ms. Gormly will seek any necessary approvals for all activities under this project from the EPA Project Coordinator.

TRC Project Manager: TRC Environmental Corporation (TRC) will be conducting the Site assessment activities of this project. The TRC Project Manager, Paul Arnold, will provide overall direction to the field investigation team including both the sampling crew and drillers.

TRC Quality Assurance Officer: TRC's Quality Assurance (QA) officer, Elizabeth Denly, will be the QA Officer responsible for this project. The QA Officer reports independently to a TRC Vice President, and hence, has full authority to act independently from the technical line management structure. She will monitor compliance of the project with this plan, and perform any necessary performance or system audits. TRC's QA Officer will initiate and monitor any necessary formal corrective actions. She will assist in preparing QA/Quality Control (QC) project summaries for the final report, including analysis of precision, accuracy and completeness of data collected.

Field Staff: A Field QC Coordinator will be selected for this project to be in charge of the field investigation. This individual will also serve as the Field Team Leader. The Field QC Coordinator will work with the field crew to prepare for field activities and conduct investigations. The Field QC Coordinator will be on Site to: 1) ensure that required QC procedures are followed for sample collection and drilling; 2) initiate informal and/or formal corrective actions, as necessary; and 3) maintain and report QC records (i.e., chain-of-custody). This individual reports to the TRC Project Manager.



3.0 APPENDIX C

3.1 Problem Definition

Former FlynnTan Manufacturing Company Site: The Former FlynnTan site (the “site”), located at 70-92 Boston Street, is currently owned by the City of Salem (the City). The site is approximately 1.9 acres in size and is bordered to the south by Boston Street and to the north by Goodhue Street. The site currently contains four separate, vacant buildings, three of which are enclosed by a perimeter fence with a locking gate, and the fourth is securely locked. Available records indicate the site was historically occupied by commercial and manufacturing operations from prior to 1900 until approximately 1999. Flynn and Sons operated a leather tannery on site from approximately 1922 until approximately 1988. Based on an interview with Thomas St. Pierre of the City of Salem Public Property Department, small commercial operations took place on site until 1999, including a small metals recycling business.

Site buildings include the main factory building, a storage building, and a garage/storage shed. The main entrance to the site is located on Boston Street. Parking areas and secondary entrances are located to the northwest, southeast and the northeast ends of the site. To the east of the parking area located northwest of the main building is the location of a former site building. This area was filled in after the building was demolished, sometime after the FlynnTan factory closed in the 1990s.

The area surrounding the site is comprised primarily of commercial and residential properties. The North River, an inlet to Salem Harbor, is located approximately ½ mile northeast of the site. A feeder canal to the North River runs east to west approximately 500 feet north of the site. Salem’s downtown center is located approximately ¾ miles east of the site. Because of its prime location, the City of Salem plans to redevelop the FlynnTan site with new buildings consisting of mixed-use residential and retail spaces that will serve as part of a revitalized corridor representing the “entrance” to the City.

Based on the extensive history of industrial uses including leather products manufacturing on site, assessment of subsurface conditions at this site is warranted.

61 Ward Street Site: The 61 Ward Street site (the “site”) is approximately 965 square feet in size and is situated in a mixed residential/commercial area. The site is developed with a one-story, vacant brick building and a small paved area. The site is bordered to the north by Peabody Street and bordered to the south by Ward Street. A substation is located approximately 300 feet northwest of the site, adjacent to a municipal parking lot, on the north side of Peabody Street. A small parking lot borders the site to the west. Further west are multiple-family residential buildings. Several commercial properties are located south of the site along Ward Street. Directly east of the site, across the intersection of Peabody, Ward, and Congress Streets, is Shetland Corporate Park. Salem center is located approximately ¼ mile northwest of the site.

The site was historically used for a number of commercial purposes since the late 1800s. Earliest available information indicates a photo shop occupied the site in 1890. The building currently occupying the site was constructed around 1920. From approximately 1937 to 1983, the site was used for several different automotive service stations. Historical street directories for Salem indicate site uses included gas stations until 1960, a taxi garage from 1960 to 1968, and an automobile repair garage until approximately 1983. Tax assessor's records indicate that Frederick D. Small took ownership of the site in 1986 and renovated the existing building for office use.

During an August 2001 site reconnaissance, TRC observed assorted paints, maintenance supplies and household cleaners in the storage area within the site building. A surface depression was noted in the asphalt-paved area adjoining the west side of the building. A hydraulic lift is believed to have been located in the former automotive repair area. A grassy area on the east side of the building was reportedly the location of the former fuel pumping area. Based on available information from City of Salem and Fire Department, there are no records of registered underground storage tanks (USTs) or the removal of USTs for the site. However, due to historic, automotive service activities, USTs are considered likely to be present at the site.

The City of Salem anticipates the 61 Ward Street site will be redeveloped for uses related to a planned urban riverfront parkway to be constructed on the adjacent properties located to the north, along Peabody Street.

Due to the previous industrial uses of this site, including automobile repair and maintenance activities, assessment of subsurface conditions at this site is warranted.

4.0 APPENDIX D

4.1 Project Description

The City of Salem is currently implementing a Brownfields Demonstration Pilot Program for EPA. Portions of this program include environmental sampling of various media at selected sites that have been identified, and may include assessment of some sites that have not yet been identified. This Quality Assurance Project Plan (QAPP), which is required as part of the City's Grant Agreement with EPA, documents proposed sampling and monitoring activities to be implemented during the Brownfields Program. The plan describes the QA/QC procedures to be employed to ensure the integrity, validity, and usability of the analytical results to be provided in support of this project.

This document was prepared in accordance with the following EPA documents:

- Quality Assurance Guidance for Conducting Brownfields Site Assessments (EPA-540-R-98-038), dated September 1998; and
- QA/R-5, EPA Requirements for Quality Assurance Project Plans (EPA – 240/B-01/003), dated March 2001.

This plan defines sampling strategies, methods, and locations, analytical methods, data handling and tracking procedures, and specific QC procedures and QA mechanisms that will be used for this Brownfields Program. The purpose of the QAPP is to establish procedures to ascertain the precision, accuracy and representativeness, and objectives for the collected data.

Former FlynnTan Manufacturing Company Site:

The former FlynnTan Manufacturing Company was involved in the softening, cutting and dyeing of leather. Potential contaminant source areas related to previous industrial use of the site include numerous sumps and trenches, a concrete underground vault, three or more USTs, stained surface soils, former chemical vats, and unspecified fill material, as discussed below. Figure D-1 shows the features and layout of the site.

Figure D-1 Site Plan – Former FlynnTan Manufacturing Company Site

During operation of the tannery, various chemicals and hazardous materials were used and stored on site in association with these processes. Former areas and structures in which hazardous materials were used and stored included leather-processing vats, dipping tanks, tumblers, settling tanks, storage tanks, drums and floor trenches. Two on-site USTs (one 20,000-gallon fuel oil UST and one 9,800-gallon UST with contents not reported) are recorded in Fire Department records for the site. Although the Fire Department records did not indicate the location of these USTs, based on existing surficial features (e.g. the presence of fill and vent pipes, broken pavement, etc.) it appears three USTs are located within the parking area northwest of the main building, and additional USTs may be located near the loading dock of the main building and east of the storage building.

In September through November 1998, EPA conducted a Removal Action at the site to address hazardous materials that were abandoned at the site and were considered a threat of a release. EPA's removal action included the removal of hazardous materials located in drums and aboveground storage tanks in the buildings, as well as the removal of liquids and sludges present in several recessed drainage trenches and pits located below the floors of the buildings. Wastes removed during the EPA Removal Action were disposed off site. The on-site USTs were not addressed as part of the 1998 EPA Removal Action.

During an August 2001 site reconnaissance, TRC observed wood, glass, and metal debris on site including a large pile of light ballasts. TRC observed approximately 20 empty drums located in several areas around the site. An underground structure, referred to in EPA Removal Program documents as a "sealed concrete vault", is located northwest of the main building. The contents and/or former use of this vault structure are unknown. TRC also observed stained soils in two locations at the site. A storm water catch basin, as well as numerous raceways and sumps, are located on site. A former transformer pad is located on the north side of the storage building.

Potential source areas for this site are summarized in the table below and are indicated on Figure D-1.

Former FlynnTan Manufacturing Company Site			
No.	Potential Source Area	Location/Description	Contaminants of Concern
1	Previous on-site industrial uses	Tannery and leather manufacturing operations on site 1922-1988. Metals shop and mixed commercial uses 1988-1999.	VOCs, VPH, EPH, SVOCs, PCBs, Metals, cyanide, Cr ⁺⁶
2	Filled areas	Former site building area.	VPH, EPH, SVOCs, PCBs, Metals
3	USTs	Northern portion of site, loading dock on south side of main building, and east of storage building annex. Contents, conditions of tanks, etc. need further evaluation.	VOCs, VPH, EPH, SVOCs, Metals, cyanide, Cr ⁺⁶
4	Subsurface Vault	Northwest portion of site, west of paved parking area.	VOCs, VPH, EPH, SVOCs, Metals, cyanide, Cr ⁺⁶
5	Stormwater Catch Basin	South of storage building.	VOCs, VPH, EPH, SVOCs, PCBs, Metals, cyanide, Cr ⁺⁶
6	Trenches, raceways, and sumps	Throughout floors of storage building and main building.	VOCs, VPH, EPH, SVOCs, Metals, cyanide, Cr ⁺⁶
7	Former transformer pad	Northeast side of storage building.	PCBs
8	Drums	Empty drums located in several areas around the site; potential for past leaking of wastes or chemicals.	VOCs, VPH, EPH, SVOCs, PCBs, Metals, cyanide, Cr ⁺⁶
9	Stained soils	Pile in northern storage building and surface soils west of single car garage.	VOCs, VPH, EPH, SVOCs, PCBs, Metals, cyanide, Cr ⁺⁶
10	Site Ground Water	Impacts due to potential discharges from below-ground structures, including USTs, sumps and drainage conduits.	VOCs, VPH, EPH, SVOCs, PCBs, Metals, cyanide

VOCs - Volatile Organic Compounds;
EPH – Extractable Petroleum Hydrocarbons;
PCBs – Polychlorinated biphenyls; and

VPH – Volatile Petroleum Hydrocarbons;
SVOCs – Semivolatile Organic Compounds;
Cr⁺⁶ – Hexavalent chromium

The following activities are planned as part of the Site investigation.

EPA File Review

A file review will be performed at the EPA Region 1 Office in Boston, Massachusetts to update information regarding the regulatory history of the Site and to review EPA records regarding sump and raceway contents pumped in 1998.

Geophysical Survey

A geophysical survey will be conducted at the site to evaluate the presence of potential USTs, subsurface drainage structures, vault(s) and potential buried debris from the former site building demolished in approximately 1988. The results of the geophysical work will be used to identify some of the target locations that warrant subsurface investigation under the tasks described below.

Hazardous Materials Survey

The site buildings shall be inspected for the presence of hazardous materials and/or wastes. A complete inventory of the hazardous and potentially hazardous materials (including, but not limited to, flammable liquids, mercury switches, PCB-containing ballasts or transformers, suspect lead paint, and suspect asbestos) will be compiled to evaluate the need for further testing.

Soil Borings and Monitoring Well Program

Based on information gathered during previous EPA inspections at the site, as well as data collected during the initial stages of this assessment, a total of ten soil borings will be advanced at the site, and seven of the soil borings will be completed as monitoring wells. Soil and ground water samples will be collected at these locations, as described below, in order to assess the nature and extent of subsurface contamination. Based on local topography, ground water at the site is expected to flow in a northeasterly direction.

Soil borings/monitoring wells will be advanced in the following locations:

- (1) Near the northeast edge of the former on-site building, close to Goodhue Street. Boring to be completed as a monitoring well;
- (2), (3), (4) Near each UST/potential UST area: (a) near loading dock on south side of main building and (b) east of storage building annex and (c) in northern portion of site, north of former site building. Three borings to be completed as monitoring wells;
- (5), (6) Near sump area in main building and one near sump area in storage building. Two borings to be completed as monitoring wells;

- (7), (8) Near areas of stained soil, northeast of the main building, and northwest of storage building annex. Two soil borings to be installed;
- (9) Near the northwest end of the main tannery building, downgradient from elevator. Boring to be completed as a monitoring well; and
- (10) Near a former equipment area in the southeast portion of the storage building annex. Soil boring to be installed.

Soil samples will be obtained continuously at two-foot intervals up to a depth of ten feet, and every five feet thereafter until groundwater or refusal is encountered, during the advancement of borings and/or monitoring wells. Soil samples will be screened continuously in the field for VOCs using the jar headspace method. Immediately upon collecting the sample, TRC will pass a photoionization detector (PID) or equivalent over the surface of the sample and note any organic vapor readings above background. If VOC and/or VPH analysis is required, samples from each depth interval should be immediately and carefully placed (in a manner to minimize volatilization) in preserved vials upon collection, and then immediately placed on ice. Soil recovered from each depth interval will be placed into stainless steel bowls using stainless steel spoons (all equipment to be decontaminated properly prior to use).

Soil recovered from each depth interval will be placed into stainless steel bowls using stainless steel spoons (all equipment to be decontaminated properly prior to use).

Next, soils for headspace screening will be transferred for each depth interval into glass jars ($\geq 8\text{oz.}$) and capped with foil followed by a screw-on lid. Then, samples will be containerized from remaining soils for each depth interval for other potential soil analyses, and immediately placed on ice. After at least 30 minutes, soil headspace readings will be obtained by removing the sample caps from each jar and inserting a PID or equivalent through the foil to measure the organic vapor concentration in the headspace. All soil headspace readings will be recorded. Based on field observations (e.g., visual and/or olfactory evidence of contamination) and jar headspace screening results, TRC will select the specified number of soil sample(s) from each boring and/or monitoring well to be submitted to an off-site laboratory for analysis.

Unless otherwise noted, one soil sample from each of the ten proposed soil borings and/or monitoring wells will be submitted to a Massachusetts-certified laboratory for VOCs, VPH, EPH, Metals, pH and oxidation-reduction potential (ORP) analyses. The soil samples collected from borings in the vicinity of the former on-site building, potential USTs, and subsurface drainage structures (described under items 1 through 6, above) will also be analyzed for SVOCs and total cyanide. The soil samples collected from borings in the vicinity of the freight elevator and the observed stained soil areas (described under items 7 through 9, above) will also be analyzed for PCBs. If elevated chromium concentrations are detected in soil samples (i.e., above MCP reportable concentrations) and if the pH and ORP analyses reveal the

presence of an oxidizing environment, then these samples will subsequently be analyzed for hexavalent chromium.

Ground water samples collected in each of the seven monitoring wells installed at the site will be submitted to a Massachusetts-certified laboratory for VOCs, VPH, EPH, Metals and Cyanide analyses. In addition, the ground water samples collected from the two monitoring wells installed in the vicinity of the subsurface drainage structures and the freight elevator (described above under items 5, 6 and 9) will be submitted for SVOC analysis. The ground water sample collected from the monitoring well near the freight elevator will be also analyzed for PCBs.

Ground Water Elevation Survey and SPH Measurements

Following the installation and development of the monitoring wells, the wells will be surveyed to an arbitrary site datum, depth to ground water readings will be recorded, and the wells will be gauged for the presence of separate phase hydrocarbons (SPH). The survey information, in conjunction with the depth to ground water readings, will be used to evaluate shallow ground water flow across the Site.

Phase II Report

A Phase II report will be prepared which will include a summary of the work conducted, site history, and site testing results based on TRC's proposed work. Further information concerning the Phase II report is provided in Section 16 (Appendix P).

61 Ward Street Site:

The existing site building was constructed around 1920. Prior to 1920, site uses reportedly included residential uses, and use as a photo shop for an unreported period of time around 1890. From approximately 1937 to 1983, the site was used as an automotive garage, and occupied by gasoline service stations until 1960, a taxi garage from 1960 to 1968, and an automobile repair garage until approximately 1983. In approximately 1986, the site was remodeled into a maintenance office and storage space related to the adjacent apartment buildings along Ward Street. Soon thereafter, the site was vacated and has reportedly remained vacant since.

The on-site building, during its previous use as an automotive garage, was described by neighboring business occupants as including a hydraulic lift in the main entrance area facing eastward. The currently existing grassy area, located east of the main entrance, was the location of the former fuel pumping area. Based on available information from City of Salem Fire Department, there are no records of registered USTs or the removal of USTs from the site. However, due to historic, automotive service activities, USTs are considered to be present at the site. During a recent site visit on March 23, 2004, TRC observed a potential petroleum-storage fill cap in the sidewalk along Ward Street (along the southern site boundary).

Potential source areas for this site are summarized below and are indicated on Figure D-2.

Figure D-2 Site Plan – 61 Ward Street Site

61 Ward Street Site			
No.	Potential Source Area	Location/Description	Contaminants of Concern
1	Former on-site gasoline service station and vehicle maintenance area	Site occupied by gas stations and auto repair garage 1937-1983.	VOCs, VPH, EPH, Metals
2	USTs, former fill pumps, and associated piping	Potential USTs located on site. Contents, conditions of tanks etc. need further evaluation. Former fill pumps located in eastern (grassy) portion of site.	VPH, EPH, Metals
3	Filled areas	Areas where USTs may have been removed from the site (i.e., depression on west side of building).	VPH, EPH, Metals
4	Hydraulic lifts	Records indicate hydraulic lift(s) may have been located in former on-site garage.	VOCs, VPH, EPH, Metals, and PCBs
6	Household hazardous wastes	Throughout site building (last use was a maintenance office for surrounding properties).	VOCs, VPH, EPH, Metals
8	Former photo shop	Historical records indicate photo shop occupied site around 1890 for an unreported period of time.	Metals
9	Site Ground Water	Potential impacts from historic USTs, gasoline filling activities, and vehicle maintenance.	VPH, EPH, Metals

VOCs - Volatile Organic Compounds;
EPH - Extractable Petroleum Hydrocarbons; and

VPH - Volatile Petroleum Hydrocarbons;
PCBs - Polychlorinated biphenyls.

The following activities are planned as part of the Site investigation.

Geophysical Survey

A geophysical survey will be conducted at the site to evaluate the presence of potential USTs and piping in the eastern portion of the site, as well as in the location of the former auto repair garage to evaluate the presence of buried hydraulic lifts. The results of the geophysical work will be used to identify target locations that warrant subsurface investigation under the tasks described below.

City of Salem Brownfields QAPP
Former FlynnTan Manufacturing Company and
61 Ward Street
Salem, MA

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Hazardous Materials Survey

The site building shall be inspected for the presence of hazardous materials and/or wastes. An inventory of hazardous materials (including, but not limited to, flammable liquids, mercury switches, PCB-containing ballasts or transformers, suspect lead paint, and suspect asbestos) will be compiled to evaluate the need for further testing.

Soil Borings and Monitoring Well Program

Based on observations and historic information gathered during the initial stages of this assessment, three soil borings will be advanced at the Site and completed as monitoring wells. Based on local topography, ground water at the site is expected to flow in a northerly direction. Soil and ground water samples will be collected in each of the boring/monitoring well locations in order to assess the nature and extent of subsurface contamination.

Soil borings/monitoring wells will be advanced in the following locations:

- (1) near the northwest corner of the site, in a location interpreted to be downgradient from the surface depression in the asphalt-paved area on the site;
- (2) north of the site building, near Peabody Street, in a location interpreted to be downgradient from the former automobile service area and potential hydraulic lift(s); and
- (3) in the northeast portion of the site, in a location interpreted to be downgradient from the former gasoline fill pumps.

Soil samples will be obtained continuously at two-foot intervals up to a depth of ten feet, and every five feet thereafter until groundwater or refusal is encountered, during the advancement of borings and/or monitoring wells. Soil samples will be screened continuously in the field for VOCs using the jar headspace method. Immediately upon collecting the sample TRC will pass a photoionization detector (PID) or equivalent over the surface of the sample and note any organic vapor readings above background. If VOC and/or VPH analysis is required, samples from each depth interval should be immediately and carefully placed (in a manner to minimize volatilization) in preserved vials upon collection, and then immediately placed on ice. Soil recovered from each depth interval will be placed into stainless steel bowls using stainless steel spoons (all equipment to be decontaminated properly prior to use).

Next, soils for headspace screening will be transferred for each depth interval into glass jars ($\geq 8\text{oz.}$) and capped with foil followed by a screw-on lid. Then, samples will be containerized from remaining soils for each depth interval for other potential soil analyses, and immediately placed on ice. After at least 30 minutes, soil headspace readings will be obtained by removing the sample caps from each jar and inserting a PID or equivalent through the foil to measure the organic vapor concentration in the

headspace. All soil headspace readings will be recorded. Based on field observations (e.g., visual and/or olfactory evidence of contamination) and jar headspace screening results, TRC will select the specified number of soil sample(s) from each boring and/or monitoring well to be submitted to an off-site laboratory for analysis.

One soil sample from each boring will be selected for submittal to a Massachusetts-certified laboratory for analysis of VPH, EPH, and metals. In each boring, one sample may also be selected based on field observations and headspace readings and submitted for VOC analysis. The soil sample collected in the boring located downgradient from the former vehicle maintenance area (north of the site building) will also be submitted for PCB analysis.

Ground water samples will be collected from each of the three monitoring wells and submitted to a Massachusetts-certified laboratory for VPH, EPH and metals analyses.

Ground Water Elevation Survey and SPH Measurements

Following the installation and development of the monitoring wells, the wells will be surveyed to an arbitrary site datum, depth to ground water readings will be recorded, and wells will be gauged for the presence of SPH. The survey information, in conjunction with the depth to ground water readings, will be used to evaluate shallow ground water flow across the Site.

Phase II Report

A Phase II report will be prepared which will include a summary of the work conducted, site history, and site testing results based on TRC's proposed work. Further information concerning the Phase II report is provided in Section 16 (Appendix P).

4.2 Project Timeline

Activities (List Products)	Project Start	Project End
Final QAPP Submission	03/08/04	04/28/04
EPA Approval		05/10/04
Site Testing	05/13/04	06/15/04
Phase II Report	06/01/04	08/16/04

5.0 APPENDIX E

5.1 Sampling Design

Field work will be performed in accordance with TRC's Standard Operating Procedures (SOPs), which are attached to this document. TRC will enlist the services of a qualified drilling subcontractor to advance soil borings and install ground water monitoring wells as set forth in Appendix D, the Project Description. Each boring and/or well will be advanced using either the hollow-stem auger technique or a GeoProbe. TRC will be responsible for the collection of soil samples for field screening and laboratory analysis during boring and well placement activities. GeoProbe sampling will be performed in accordance with the MADEP Standard References for Monitoring Wells, Supplement for Small Diameter Driven Wells.

Soil samples will be collected continuously at two-foot intervals to a depth of ten feet. Below ten feet, samples will be collected at a minimum of five-foot intervals. Samples will be screened using a PID, or equivalent, and any odors or visual indication of contamination will be noted. Equipment will be decontaminated between soil borings to reduce the possibility of cross-contamination.

Based on jar headspace screening observations, one soil sample from each of the borings will be selected for laboratory analysis. If no indications of possible contamination are observed, one soil sample will be collected immediately above the ground water interface and submitted for analysis. Soil samples from the borings will be submitted to a Massachusetts-certified laboratory for analysis.

Ground water monitoring wells will be constructed of two-inch diameter Schedule 40 PVC. The pipe sections will be threaded screw type, eliminating the need for solvent-based glue. Each well will have a 10-foot, 10-slot (0.010-inch machine slotted) screen section placed so as to extend above and below the upper surface of the water table. A sand pack will be placed around the screen extending to a level approximately one foot above the top of the screen. A bentonite seal approximately two feet thick will be placed above the sand pack in order to seal off the screened portion of the well from the overlying strata. The remainder of the well annulus will be filled with a cement/bentonite grout to ground surface. A locking steel protective cover will be installed over the top of the wells and the cap will be flush with the ground surface for any wells located in paved areas.

After installation, each well will be developed by removing at least three well volumes by purging with a submersible or peristaltic pump. Headspace measurement of VOCs will be made on purged ground water using the field screening equipment. If the headspace VOC reading exceeds 10 parts per million (ppm), the purge water will be drummed or containerized until the ground water sample test results are obtained to evaluate disposal options. If the headspace VOC readings are less than 10 ppm, the water will be discharged onsite.

Monitoring wells will be allowed to stabilize for a period of at least seven days prior to sampling. At this time the water level in the wells will be surveyed in an attempt to confirm the direction of ground water flow at the sites.

Following the well installation and development process, TRC will collect ground water samples from each monitoring well to determine whether Site use has impacted ground water conditions at the Site. Samples will be obtained using low-flow sampling techniques. TRC will submit the ground water samples to a laboratory for chemical analysis. Prior to ground water sample collection, TRC will also measure water levels to assist in data interpretation. TRC will measure well casing elevations and prepare a Site sketch with taped distance measurements for use in drafting an approximated ground water contour plan.

All soil and ground water samples from the Site will be placed on ice, kept cool ($4^{\circ}\text{C} \pm 2^{\circ}\text{C}$) and will be delivered to an off-site laboratory following proper chain-of-custody procedures. A trip blank and field duplicate samples will also be collected to provide quality assurance/quality control data.

5.2 Equipment Decontamination Procedures

All major decontamination of downhole and excavation equipment will be conducted at a designated decontamination area(s). When appropriate, drill rigs will be steam cleaned and drilling equipment will be decontaminated prior to moving. Drilling equipment used for multiple boreholes will be decontaminated by steam cleaning prior to beginning each boring. (Split-spoons should be made of stainless steel, but carbon steel is acceptable if it is rust-free.)

Minor decontamination such as cleaning of sampling equipment will be performed at each sampling site. Smaller sampling equipment such as split spoons, stainless steel or Teflon spatulas and stainless steel mixing pans will be decontaminated using the following procedures:

- Wash and scrub with low-phosphate detergent in tap water;
- Rinse with deionized water;
- Rinse with nitric acid (10% nitric acid for stainless steel equipment and 1% nitric acid on all other equipment);
- Rinse with pesticide-grade methanol;
- If oily, rinse with pesticide-grade hexane;
- Air dry - on clean polyethylene sheeting;
- Rinse with deionized water;
- Air dry - on clean polyethylene sheeting;
- Wrap in aluminum foil, shiny side out for transport; and
- Clean equipment may rest on - but never be wrapped in - clean polyethylene sheeting.

Soils (excess sample volume, auger cuttings, etc.) will be returned to their place of origin (either placed inside of the boreholes or dispersed near the borehole location). The PID and visual observations will be used to determine if residuals require further handling and disposal (e.g., off-site disposal as RCRA wastes). Residuals screened for disposal as a hazardous material will be properly disposed of by the City of Salem.

6.0 APPENDIX F

6.1 Sampling and Analytical Methods Requirements

Table F-1 Sampling and QA Summary Former FlynnTan Manufacturing Company Site - Salem, MA							
Sample Matrix	Parameter	Sample Type ^{(A), (B)}	Number of Samples ^{(A), (C)}	Analytical Method Reference	Sample Preservation	Holding Time from Collection	Container ^(B)
Soil	VOCs	Field Sample, Trip Blank, Field Duplicate (FD) and MS/ MSD	10 samples, 3 Trip Blanks, 1 FD and 1 MS/MSD	SW-846 Method 5035A/8260B (WSC-CAM-IIA)	Methanol - preserved in the field and Cool to 4°C (high-level); and water – preserved in the field and Cool to 4°C (low-level).	High-Level: 14 days to analysis Low-Level: 48 hours to freezing at <- 7°C; 14 days to analysis	2-40 mL Methanol preserved VOA vials (high-level); or 2-40 mL vials with lab reagent water and magnetic stir bar (low-level)
Soil	VPH	Field Sample, Trip Blank, FD and MS/ DUP	10 samples, 3 Trip Blanks, 1 FD and 1 MS/ DUP	MA DEP Method (January 1998) Rev. 0 (WSC-CAM-IVA)	Methanol preserved in the field and Cool to 4°C	28 days to analysis	2-40 mL Methanol preserved VOA vials
Soil	EPH	Field Sample, Field Duplicate and MS/DUP	10 samples, 1 FD and 1 MS/DUP	MA DEP Method (January 1998) Rev. 0 (WSC-CAM-IVB)	Cool to 4°C	7 days to extraction; 40 days from extraction to analysis	1-4 oz glass jar w/Teflon lined cap
Soil	MCP Metals plus Mercury	Field Sample, Field Duplicate and MS/DUP	10 samples, 1 FD and 1 MS/DUP	SW-846 Method 6010B Method 7471A (WSC-CAM-IIIA and IIIB)	Cool to 4°C	Mercury: 28 days Other Metals: 180 days	1-8 oz. Polyethylene/glass bottle and cap
Soil	Hexavalent Chromium	Field Sample, Field Duplicate and MS/DUP	TBD	SW-846 methods 3060A/7196A (WSC-CAM-VIB)	Cool to 4°C	30 days to extraction; 7 days to analysis	4 oz. glass jar
Soil	SVOCs	Field Sample, Field Duplicate and MS/MSD	6 samples, 1 FD and 1 MS/MSD	SW-846 Method 8270C (WSC-CAM-IIB)	Cool to 4°C	14 days to extraction; 40 days from extraction to analysis	1-4 oz glass jar w/Teflon lined cap

Table F-1 Sampling and QA Summary
Former FlynnTan Manufacturing Company Site - Salem, MA

Sample Matrix	Parameter	Sample Type ^{(A), (B)}	Number of Samples ^{(A), (C)}	Analytical Method Reference	Sample Preservation	Holding Time from Collection	Container ^(B)
Soil	Total Cyanide	Field Sample, Field Duplicate and MS/DUP	6 samples, 1 FD and 1 MS/DUP	SW-846 method 9010B/9014 (WSC-CAM-V1A)	Cool to 4°C	14 days to analysis	1-8 oz. Polyethylene/glass bottle and cap
Soil	pH	Field Sample, Field Duplicate and DUP	10 samples, 1 FD and 1 DUP	SW-846 method 9045C	Cool to 4°C	24 hours to analysis	1-4 oz glass jar w/Teflon lined cap
Soil	ORP	Field Sample, Field Duplicate and DUP	10 samples, 1 FD and 1 DUP	ASTM Method D1498-00, modified	Cool to 4°C	24 hours to analysis	1-4 oz glass jar w/Teflon lined cap
Soil	PCBs	Field Sample, Field Duplicate and MS/MSD	3 samples, 1 FD and 1 MS/MSD	SW-846 Method 8082 (WSC-CAM-VA)	Cool to 4°C	14 days to extraction; 40 days from extraction to analysis	1-8oz wide mouth glass jar with Teflon lined septa
Ground Water	VOCs	Field Sample, Field Duplicate, MS/MSD and Trip Blank	7 samples, 1 Trip Blank, 1 FD and 1 MS/MSD	SW-846 Method 8260B (WSC-CAM-IIA)	Cool to 4°C; HCl to pH <2	14 days to analysis	2-40 mL VOA vials with Teflon-faced septa
Ground Water	VPH	Field Sample, Field Duplicate, MS/DUP and Trip Blank	7 samples, 1 Trip Blank, 1 FD and 1 MS/DUP	MA DEP Method (January 1998) Rev. 0 (WSC-CAM-IVA)	Cool to 4°C; HCl to pH <2	14 days to analysis	2-40 mL VOA vials with Teflon-faced septa
Ground Water	EPH	Field Sample, Field Duplicate and MS/DUP	7 samples, 1 FD and 1 MS/DUP	MA DEP Method (January 1998) Rev. 0 (WSC-CAM-IVB)	Cool to 4°C; HCl to pH <2	14 days to extraction; 40 days from extraction to analysis	2-1 liter glass jars w/Teflon lined cap
Ground Water	MCP Metals plus Mercury	Field Sample, Field Duplicate and MS/DUP	7 samples, 1 FD and 1 MS/DUP	SW-846 Methods 6010B and 7470A (WSC-CAM-IIIA and IIIB)	Cool to 4°C; HNO ₃ to pH <2	Mercury: 28 days Other Metals: 180 days	1-1 liter glass or polyethylene bottle and cap
Ground Water	Total Cyanide	Field Sample, Field Duplicate and MS/DUP	7 samples, 1 FD and 1 MS/DUP	SW-846 Method 9010B/9014 (WSC-CAM-VIA)	NaOH to pH>12 Cool to 4°C	14 days to analysis	1-1 liter polyethylene bottle and cap

<p align="center">Table F-1 Sampling and QA Summary Former FlynnTan Manufacturing Company Site - Salem, MA</p>							
Sample Matrix	Parameter	Sample Type ^{(A), (B)}	Number of Samples ^{(A), (C)}	Analytical Method Reference	Sample Preservation	Holding Time from Collection	Container ^(B)
Ground Water	SVOCs	Field Sample, Field Duplicate, and MS/MSD	3 samples, 1 FD and 1 MS/MSD	SW-846 Method 8270C (WSC-CAM-IIB)	Cool to 4°C	7 days to extraction; 40 days from extraction to analysis	2-1 liter glass jars w/Teflon lined cap
Ground Water	PCBs	Field Sample	1 sample	SW-846 Method 8082 ^(D) (WSC-CAM-VA)	Cool to 4°C	7 days to extraction; 40 days from extraction to analysis	2-1 liter glass jars w/Teflon lined cap

(A) MS/MSD = Matrix spike/matrix spike duplicate samples; MS/DUP = Matrix spike/duplicate samples; and FD = Field Duplicate samples.

(B) Due to the low number of groundwater samples to be analyzed for PCBs (i.e., only one field sample), quality control samples (i.e., Field Dupe, MS/MSD) will not be submitted for PCB analysis of groundwater.

(C) MS/MSD and MS/DUP samples require triplicate volume for water samples.

(D) Method will be modified to allow for a final extract volume of 2 mL.

TBD – To Be Determined based upon results of pH, ORP, and total chromium.

**Table F-2 Sampling and QA Summary
61 Ward Street Site - Salem, MA**

Sample Matrix	Parameter	Sample Type ^{(A), (B)}	Number of Samples ^{(A), (C)}	Analytical Method Reference	Sample Preservation	Holding Time from Collection	Container ^(B)
Soil	VOCs	Field Sample, Trip Blank, Field Duplicate and MS/ MSD	3 samples, 1 Trip Blank, 1 FD and 1 MS/MSD	SW-846 Method 5035A/8260B (WSC-CAM-IIA)	Methanol - preserved in the field and Cool to 4°C (high-level); and water –preserved in the field and Cool to 4°C (low-level).	High-Level: 14 days to analysis Low-Level 48 hours to freezing at < -7°C; 14 days to analysis	2-40 mL Methanol preserved VOA vials (high-level); or 2-40 mL vials with lab reagent water and magnetic stir bar (low-level)
Soil	VPH	Field Sample, Trip Blank, Field Duplicate (FD) and MS/DUP	3 samples, 1 Trip Blank, 1 FD and 1 MS/DUP	MA DEP Method (January 1998) Rev. 0 (WSC-CAM-IVA)	Methanol preserved in the field and Cool to 4°C	28 days to analysis	2-40 mL Methanol preserved VOA vials
Soil	EPH	Field Sample, Field Duplicate and MS/DUP	3 samples, 1 FD and 1 MS/DUP	MA DEP Method (January 1998) Rev. 0 (WSC-CAM-IVB)	Cool to 4°C	7 days to extraction; 40 days from extraction to analysis	1-4 oz glass jar w/Teflon lined cap
Soil	MCP Metals plus Mercury	Field Sample, Field Duplicate and MS/ DUP	3 samples, 1 FD and 1 MS/DUP	SW-846 Method 6010B Method 7471A (WSC-CAM-IIIA and IIIB)	Cool to 4°C	Mercury: 28 days Other Metals: 180 days	1-8 oz. Polyethylene/glass bottle and cap
Soil	PCBs	Field Sample	1 sample	SW-846 Method 8082 (WSC-CAM-VA)	Cool to 4°C	14 days to extraction; 40 days from extraction to analysis	1-8oz wide mouth glass jar with Teflon lined septa
Ground Water	VPH	Field Sample, Field Duplicate, MS/DUP and Trip Blank	3 samples, 1 Trip Blank, 1 FD and 1 MS/DUP	MA DEP Method (January 1998) Rev. 0 (WSC-CAM-IVA)	Cool to 4°C; HCl to pH <2	14 days to analysis	2-40 mL VOA vials with Teflon-faced septa
Ground Water	EPH	Field Sample, Field Duplicate and MS/DUP	3 samples, 1 FD and 1 MS/DUP	MA DEP Method (January 1998) Rev. 0 (WSC-CAM-IVB)	Cool to 4°C; HCl to pH <2	14 days to extraction, 40 days from extraction to analysis	2-1 liter glass jars w/Teflon lined cap

Table F-2 Sampling and QA Summary 61 Ward Street Site - Salem, MA							
Sample Matrix	Parameter	Sample Type ^{(A), (B)}	Number of Samples ^{(A), (C)}	Analytical Method Reference	Sample Preservation	Holding Time from Collection	Container ^(B)
Ground Water	MCP Metals plus Mercury	Field Sample, Field Duplicate and MS/DUP	3 samples, 1 FD and 1 MS/DUP	SW-846 Methods 6010B and 7470A (WSC-CAM-IIIA and IIIB)	Cool to 4°C; HNO ₃ to pH <2	Mercury: 28 days Other Metals: 180 days	1-1 liter glass or polyethylene bottle and cap

(A) MS/MSD = Matrix spike/matrix spike duplicate samples; MS/DUP = Matrix spike/duplicate samples; and FD = Field Duplicate samples.

(B) Due to the low number of soil samples to be analyzed for PCB (i.e., only one field sample), quality control samples (i.e., Field Dupe, MS/MSD) will not be submitted for PCB analysis of soils.

(C) MS/MSD and MS/DUP samples require triplicate volume for water samples.

6.2 Method and SOP References

Analytical Method Reference:		Project Analytical Standard Operating Procedures (SOPs):	
1a.	40 CFR 136.3e Required containers, preservative techniques, and holding times	1b.	See the Lab QA Manual (Attachment A).
2a.	Wagner, R.E., Kotas, W.A., Hotaling, I.C., Hynes, T.C., Daly, J. and McTague, M.F. (eds.). Guide to Environmental Analytical Methods, 5 th ed. Genium Publishing Corporation, Amsterdam, NY. 2003. Reference for SW-846 information on method validation, calibration guidelines, and QC checks.	2b.	Same as above
3a.	USEPA. Total and Amenable Cyanide: Distillation. SW846 Method 9010B, Revision 2. December 1996.	3b.	Same as above
4a.	USEPA. Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry. SW846 Method 8260B, Revision 2. December 1996.	4b.	Same as above
5a.	USEPA. Closed-System Purge-and-Trap and Extraction for Volatile Organics in Soil and Waste Samples. SW846 Method 5035A, Draft Revision 1. July 2002.	5b.	Same as above
6a.	USEPA. Inductively Coupled Plasma-Atomic Emission Spectrometry. SW846 Method 6010B, Revision 2. December 1996.	6b.	Same as above
7a.	USEPA. Mercury in Solid or Semisolid Waste (Manual Cold-Vapor Technique). SW846 Method 7471A, Revision 1. September 1994.	7b.	Same as above
8a.	USEPA. Mercury in Liquid Waste (Manual Cold-Vapor Technique). SW846 Method 7470A, Revision 1. September 1994.	8b.	Same as above
9a.	MADEP. Method for the Determination of Extractable Petroleum Hydrocarbons (EPH). January 1998.	9b.	Same as above
10a.	MADEP. Method for the Determination of Volatile Petroleum Hydrocarbons (VPH). January 1998.	10b.	Same as above
11a.	USEPA. Polychlorinated Biphenyls (PCB) by Gas Chromatography. SW846 Method 8082, Revision 0. December 1996.	11b.	Same as above
12a.	USEPA. Titrimetric and Manual Spectrophotometric Determinative Methods for Cyanide. SW846 Method 9014, Revision 0. December 1996.	12b.	Same as above
13a.	USEPA. Chromium Hexavalent (Colorimetric). SW846 Method 7196A, Revision 1. July 1992.	13b.	Same as above
14a.	USEPA. Semivolatile Organic Compounds by Gas Chromatography/Mass Spectrometry. SW846 Method 8270C, Revision 3. December 1996.	14b.	Same as above
15a.	USEPA. Alkaline Digestion for Hexavalent Chromium. SW846 Method 3060A, Revision 1. December 1996.	15b.	Same as above
16a.	USEPA. Soil and Waste pH. SW846 Method 9045C, Revision 3. January 1995.	16b.	Same as above

Analytical Method Reference:	Project Analytical Standard Operating Procedures (SOPs):
17a. ASTM. Standard Practice for Oxidation-Reduction Potential of Water. ASTM D1498-00.	17b. Same as above

7.0 APPENDIX G

7.1 Preventative Maintenance – Field Equipment

Instruments and equipment used to gather, generate, or measure environmental data will be calibrated with sufficient frequency and in such a manner that accuracy and reproducibility of results are consistent with the manufacturer's specifications. The calibration and internal standards shall meet all criteria specified in the referenced analytical method.

For all analyses for which EPA or DEP approved methods exist, the laboratory will employ such methods and follow the calibration procedures and frequencies specified.

Calibration of field instruments and equipment will be performed as specified by the manufacturer or more frequently as conditions dictate. The minimum calibration of field instrumentation is once at the beginning of each day, and as necessary. Calibration standards used as reference standards will be traceable to the National Institute of Standards and Technology (NIST), when existent.

Records of calibration, repair, or replacement will be filed and maintained by the designated laboratory personnel performing quality control activities. Calibration records of assigned laboratories will be filed and maintained at the laboratory location where the work is performed and subject to QA audit.

Instrument	Activity	Frequency	SOP Ref.
PID ¹	Field Sample Screening	Daily	Per Headspace Field Screening Procedure, TRC SOP 016.
Water level meter	Clean meter and visually inspect for defective parts	Daily prior to use	Per Water Level and Product Measurement SOP, TRC SOP 012
Turbidimeter	Visually inspect for defective parts	Daily prior to use	Per Calibration of Field Instruments for Water Quality Parameters SOP, TRC SOP 024
Water quality instrument (YSI or equivalent multi-parameter meter)	(See below)	(See below)	(See below).
pH Probe	Clean/visually inspect probe	Prior to initial use, and when unstable readings occur	Per Calibration of Field Instruments for Water Quality Parameters SOP, TRC SOP 024
DO Probe	Clean/visually inspect probe, change KCl, and change Teflon® membrane	Prior to initial use, and if bubbles appear below membrane, if unstable readings are given, or if dried electrolyte visible on membrane or o-ring.	(Same as above)
Specific Conductance Electrode	Clear opening to probe	Prior to initial use	(Same as above)
Thermistor-Temp. Sensor	Visually inspect probe	Daily before use	(Same as above)
ORP Electrode	Visually inspect probe	Daily before use	(Same as above)

1 - PID – Photoionization detector.

8.0 APPENDIX H

8.1 Calibration and Corrective Action – Field Equipment

Instrument	Activity	Frequency	Acceptance Criteria	Corrective Action	SOP Ref.
PID	Check calibration on site with span gas (e.g., isobutylene)	Beginning and end of day	$\pm 10\%$ of true value	Re-calibrate using manufacturer's instructions and re-check with span gas; replace if faulty.	Per TRC SOP for Headspace Field Screening Procedure.
Water level meter	TRC to perform independent check of accuracy	Prior to use	± 0.1 feet	Re-calibrate using manufacturer's instructions and re-check; replace if faulty.	Per TRC SOP for Water Level and Product Measurement.
Turbidimeter	Check calibration using standard turbidity solutions	Daily before use	$\pm 5\%$	Re-calibrate using manufacturer's instructions and re-check; replace if faulty.	Per TRC SOP for Calibration of Field Instruments for Water Quality Parameters.
YSI or equivalent water quality probe	Check accuracy using standard solutions	Daily before use	<p>Temperature – ± 0.15 °C of NIST certified thermometer</p> <p>D.O. - ± 0.2 mg/L for 0.0</p> <p>pH – stable readings ± 0.1 pH units within 3 minutes</p> <p>specific conductance- ± 1 umho/cm of standard</p> <p>ORP ± 1 mV of standard</p>	Re-calibrate using manufacturer's instructions and re-check; replace if faulty.	Per TRC SOP for Calibration of Field Instruments for Water Quality Parameters.

NA – Not applicable.

9.0 APPENDIX I

9.1 Preventative Maintenance – Laboratory Equipment

Instrument	Activity	Frequency	SOP Ref.*
GC/MS	Maintain per manufacturer's instructions	Per manufacturer's instructions	4a, 14a
ICP-AES	Maintain per manufacturer's instructions	Per manufacturer's instructions	6a
GC/ECD	Maintain per manufacturer's instructions	Per manufacturer's instructions	11a
CVAA	Maintain per manufacturer's instructions	Per manufacturer's instructions	7a, 8a
GC/FID	Maintain per manufacturer's instructions	Per manufacturer's instructions	9a, 10a
GC/PID	Maintain per manufacturer's instructions	Per manufacturer's instructions	10a
Spectrophotometer	Maintain per manufacturer's instructions	Per manufacturer's instructions	3a, 12a, 13a, 15a
pH Meter	Maintain per manufacturer's instructions	Per manufacturer's instructions	16a
ORP Meter	Maintain per manufacturer's instructions	Per manufacturer's instructions	17a

* Reference Number from Appendix F, Method and SOP Reference Table.

10.1 Calibration and Corrective Action – Laboratory Equipment

Instrument	Activity	Frequency	Acceptance Criteria	Corrective Action	SOP Ref.*
GC/MS	Initial calibration – 5 levels -one = quantitation limit	Prior to sample analysis	Response Factor (RF)>0.05 and %RSD < 30%	Service Instrument	4a, 14a
GC/MS	Continuing calibration – mid-level standard	Once every 12 hours prior to sample analysis	RF-%D ≤ 25% from initial calibration	Reanalyze continuing calibration standard. If still outside limits, recalibrate and reanalyze all samples since last compliant calibration standard.	4a, 14a
ICP-AES	Initial calibration - per instrument manufacturer's specifications – 1 level and a blank (Low-level calibration standard at quantitation limit must be analyzed if not included in initial calibration.)	Prior to sample analysis	Per manufacturer's specifications and method requirements	Run new calibration curve and/or service instrument	6a
ICP-AES	Continuing calibration –midlevel standard	Every 10 samples and at end of the analytical run	90-110%	Reanalyze continuing calibration standard. If still outside limits, recalibrate and reanalyze all samples since last compliant calibration standard.	6a
GC/ECD	Initial calibration – 5 levels -one = quantitation limit	Prior to sample analysis	Calibration Factor (CF) - % RSD ≤20% or r ≥0.99	Run new calibration curve and/or service instrument	11a
GC/ECD	Continuing calibration – mid-level standard	1 standard per 20 samples or every 12 hours, whichever is more frequent	CF – %D ≤15% from initial calibration	Reanalyze continuing calibration standard. If still outside limits, recalibrate and reanalyze all samples	11a

Instrument	Activity	Frequency	Acceptance Criteria	Corrective Action	SOP Ref.*
				since last compliant calibration standard.	
CVAA	Initial calibration – 5 levels and a blank (one level must be at quantitation limit)	Prior to sample analysis	$r \geq 0.995$	Run new calibration curve and/or service instrument	7a, 8a
CVAA	Continuing calibration – mid-level standard	Every 10 samples and at the end of the analytical run	80-120%	Reanalyze continuing calibration standard. If still outside limits, recalibrate and reanalyze all samples since last compliant calibration standard.	7a, 8a
GC/FID	Initial calibration – 5 levels -one = quantitation limit	Prior to sample analysis	CF - %RSD = 25% or $r > 0.99$	Run new calibration curve and/or service instrument	9a, 10a
GC/FID	Continuing calibration – mid-level standard	1 standard per 20 samples and at end of analytical run	CF - %D \leq 25% from initial calibration	Reanalyze continuing calibration standard. If still outside limits, recalibrate and reanalyze all samples since last compliant calibration standard.	9a, 10a
GC/PID	Initial calibration – 5 levels -one = quantitation limit	Prior to sample analysis	CF - %RSD = 25% or $r > 0.99$	Run new calibration curve and/or service instrument	10a
GC/PID	Continuing calibration – mid-level standard	1 standard per 20 samples and at end of analytical run	CF - %D \leq 25% from initial calibration	Reanalyze continuing calibration standard. If still outside limits, recalibrate and reanalyze all samples since last compliant calibration standard.	10a
Spectro-photometer – cyanide	Initial calibration – 5 levels and a blank (one level must be at quantitation limit)	Prior to sample analysis	$r \geq 0.995$	Run new calibration curve and/or service instrument	3a, 12a
Spectro-	Continuing Calibration –mid-level	Every 10 samples and at end of	85-115%	Reanalyze continuing	3a, 12a

Instrument	Activity	Frequency	Acceptance Criteria	Corrective Action	SOP Ref.*
photometer – cyanide	standard	the analytical run		calibration standard. If still outside limits, recalibrate and reanalyze all samples since last compliant calibration standard.	
Spectro-photometer – Cr+6	Initial calibration – 5 levels and a blank (one level must be at quantitation limit)	Prior to sample analysis	$r \geq 0.995$	Run new calibration curve and/or service instrument	13a, 15a
Spectro-photometer – Cr+6	Continuing calibration –mid-level standard	Every 10 samples and at end of the analytical run	80-120%	Reanalyze continuing calibration standard. If still outside limits, recalibrate and reanalyze all samples since last compliant calibration standard.	13a, 15a
pH	Initial calibration – 2 levels 3 pH units or more apart	Prior to sample analysis	± 0.05 pH units of true value	Recalibrate and/or service instrument.	16a
ORP	Initial calibration -1 level	Prior to sample analysis	$\pm 5\%$ of true value	Recalibrate and/or service instrument.	17a

* Reference Number from Appendix F, Method and SOP Reference Table.

11.0 APPENDIX K

11.1 Sample Handling and Custody Requirements

The purpose of chain-of-custody procedures is to document the identity of the sample and its handling from its first existence as a sample until analysis and data reduction are completed. Custody records trace a sample from its collection through all transfers of custody until it is transferred to the analytical laboratory. Internal laboratory records then document the custody of the sample through its final disposition.

All materials such as field and laboratory notebooks and logbooks, field and laboratory data records, correspondence, reports, chain-of-custody records and instrument printouts will be clearly labeled with the project number and become a permanent part of the project file.

11.1.1 Field Sampling Operations

Preprinted sample identification labels will be used to ensure that the required information is entered in the field. Each collected sample shall have a completely filled-in sample label securely attached. In addition, the sample identification number will be marked on the container with a permanent marker so that the sample can be properly identified even if the label is separated from the sample.

Figure K-1 shows the general sample label and custody seal that will be used to identify and seal samples in the field. Figure K-2 shows a general use chain-of-custody record. This two-part form will be used to document sample transfer in the field, from sampling personnel to the analytical laboratory.

The Field Team Leader will coordinate the packing and shipment of all samples.

TRC intends to ship all samples via a courier service or an overnight delivery service within 24 hours of collection.

Sample Label

CLIENT/SOURCE	<input type="checkbox"/> GRAB <input type="checkbox"/> COMPOSITE OTHER
SITE NAME	DATE
SAMPLE #	TIME
ANALYSIS	PRESERVATIVE
	COLL. BY

Custody Seal



	CUSTODY SEAL
	Date _____ Signature _____

Figure K-1 Sample Label and Chain-of-Custody Seal


TRC
 Customer-Focused Solutions

Boott Mills South, Foot of John Street • Lowell, Massachusetts 01852
 Telephone 978-970-5000 • Fax 978-453-1995

Chain-of-Custody Record

Project Name: _____

Project No.: _____

Sampling Date(s): _____

Laboratory Name: _____

Laboratory Location: _____

Sampler Name(s): _____

Shipping Carrier: ☐ FED EX ☐ COURIER

Date Shipped: _____

Airbill No.: _____

MCP Work Only: Have the appropriate number of field samples been collected for this program?
☐ YES ☐ NO

Turnaround Time (Circle One)
 15 Day 10 Day 5 Day 3 Day Other: _____

Page ____ of ____

ANALYSIS AND PRESERVATIVE

--	--	--	--	--	--	--	--	--	--	--	--

SAMPLE ID	DATE/TIME SAMPLED	COMPOSITE OR GRAB	MATRIX	VOLUME / CONTAINER TYPES	NUMBER OF CONTAINERS
	/			/	
	/			/	
	/			/	
	/			/	
	/			/	
	/			/	
	/			/	
	/			/	
	/			/	
	/			/	
	/			/	
	/			/	
	/			/	
	/			/	
	/			/	

COMMENTS: _____

Send results to: _____

Cooler temperature: _____

Relinquished By (Signature): _____

Relinquished By (Signature): _____

/

Date/Time

/

Date/Time

Received By (Signature): _____

Received By (Signature): _____

/

Date/Time

/

Date/Time

N^o 0020

WHITE – LABORATORY YELLOW – LABORATORY COPY PINK – OFFICE COPY GOLD – FIELD COPY

Figure K-2 Chain-of-Custody Record

11.1.2 Sample Identification

Each separate sample will be identified using the sample label shown in Figure K-1. The sampler will complete all information, using a black waterproof pen, as follows:

- A. The “Sample Number” will be the number assigned to the particular sampling station, including the depth of sampling, if relevant.

Example:

Sample “B2-2-4” indicates that the sample was taken from Boring No. 2 at the 2-4 foot interval; and

Sample “MW-1” indicates that the sample is a ground water sample taken from Well Location No. 1.

- B. The “Client/Source and Site Name” for a particular sampling event.

Example: Salem Brownfields, 242 Water Street

- C. The “Analysis” will be indicated for each sample.

Example: VPH

- D. The “Preservative” will be indicated for each sample.

Example: Methanol

- E. The “Date” will be the date the sample was collected, using the format: MM-DD-YY.

Example: 04-16-04

- F. The “Time” will be the time the sample was collected, using military time.

Example: 14:30

- G. The sampler’s name will be printed in the “Coll. By” section.

- H. The sampler will check off grab or composite box.

Prior to going to the field, this sample identification procedure will be further refined (if necessary), so that a sample is accurately and easily identified.

This sample label contains the authoritative information for the sample. Inconsistencies with other documents will be settled in favor of the vial or container label unless otherwise corrected in writing from the field personnel collecting samples.

All samples analyzed by the laboratory are to be considered to be of an evidentiary nature. The possession of samples must be traceable from the time samples are collected in the field until the analysis is completed and the data are entered as evidence. The tracing of the samples is accomplished by "chain-of-custody" procedures as follows:

- 1) A chain-of-custody record (Figure K-2) will be completed for each set of samples.
- 2) Samples will not leave custody of the field investigator until relinquished to another party.

Custody is defined as:

- 1) In actual physical possession of field personnel.
- 2) In the field personnel's view after being in physical possession.
- 3) In a locked area after being in physical possession.
- 4) In a designated, locked storage area.

11.2 Laboratory Operations

All samples submitted to the analytical laboratory selected for the project will be brought to the sample bank manager, who will continue the chain-of-custody by assigning a unique control number to each sample on receipt; this number identifies the sample through all further handling. The sample will be recorded in a Master Sample Log under its control number. Each sample entry in the Master Sample Log has the following information:

- Laboratory Control Number;
- Sample description;
- Sample condition;
- Signature of person completing sample record; and
- Date of sample receipt.

Samples shall be stored in locked storage areas with provision for hazardous material storage. The sample bank manager will store each sample in the appropriate area under the laboratory's unique control number.

The sample bank manager will initiate a log entry for each sample in the Master Sample Log and ensure that handling of each sample is appropriately documented. Each analyst working with the sample will first go to the sample bank manager and record in the Master Sample Log actions taken on the sample, thereby maintaining the chain-of-custody of the original sample.

Project samples will be disposed of in an appropriate manner by the laboratory.

12.0 APPENDIX L

12.1 Analytical Precision, Accuracy and Sensitivity

Analyte	Analytical Method	Quantitation Limit (water/soil)	Precision (water/soil)	Accuracy (water/soil)	Completeness (water/soil)
VOCs	8260B	See first table below ("Laboratory Analysis Parameter Table")	See second table below ("Laboratory Precision Accuracy Objectives")		90%
Volatile Petroleum Hydrocarbons (VPH)	MA DEP Method Rev. 0 (January 1998)				
Extractable Petroleum Hydrocarbons (EPH)	MA DEP Method Rev. 0 (January 1998)				
PCBs	8082				
Metals	6010B and 7470A/7471A				
Cyanide	9010B/9014				
Hexavalent Chromium (Cr ⁺⁶)	3060A/7196A				
SVOCs	8270C				
pH	9045C				
ORP	ASTM D1498-00				

Laboratory Analysis Parameter Table		
Parameter	Quantitation Limit Objective	
	Aqueous ug/L	Soil/Sediment ug/kg
Volatile Organic Compounds (VOCs)		
Acetone	5	5
Tert Amyl Methyl Ether (TAME)	10	10
Benzene	5	5
Bromobenzene	5	5
Bromochloromethane	5	5
Bromodichloromethane	5	5
Bromoform	5	5
Bromomethane	5	5
Butylbenzene, sec-	5	5
Butylbenzene, n-	5	5
Butylbenzene, tert-	5	5
Carbon Disulfide	5	5
Carbon Tetrachloride	5	5
Chlorobenzene	5	5
Chlorodibromomethane	5	5
Chloroethane	5	5
Chloroform	5	5
Chloromethane	5	5
Chlorotoluene 2-	5	5
Chlorotoluene 4-	5	5
1,2-Dibromo -3-chloropropane	5	5
Dibromoethane, 1,2- (EDB)	5	5
Dibromomethane	5	5
Dichlorobenzene 1,3-	5	5
Dichlorobenzene 1,2-	5	5
Dichlorobenzene 1,4-	5	5
Dichlorodifluoromethane (Freon 12)	5	5
Dichloroethane 1,1-	5	5
Dichloroethane 1,2-	5	5
Dichloroethylene 1,1-	1	5
Dichloroethylene, cis -1,2-	5	5
Dichloroethylene, trans-1,2-	5	5
Dichloropropane 1,2-	5	5
Dichloropropane 1,3-	5	5
Dichloropropane 2,2-	5	5
Dichloropropene 1,1-	5	5
Dichloropropene cis -1,3-	5	5
Dichloropropene trans-1,3-	5	5
Diethyl Ether	10	10

Laboratory Analysis Parameter Table		
Parameter	Quantitation Limit Objective	
	Aqueous ug/L	Soil/Sediment ug/kg
Diisopropyl Ether	10	10
Dioxane, 1,4-	100	100
Ethyl Tertiary Butyl Ether	10	10
Ethylbenzene	5	5
Hexachlorobutadiene	5	5
Hexanone, 2-	5	5
Isopropylbenzene (Cumene)	5	5
Isopropyltoluene, p-	5	5
Methyl Ethyl Ketone (MEK)	5	5
Methyl Isobutyl Ketone (MIBK)	5	5
Methyl Tertiary Butyl Ether (MTBE)	5	5
Methylene Chloride	5	5
Naphthalene	5	5
Propylbenzene, n-	5	5
Styrene	5	5
Tetrachloroethane 1,1,1,2-	5	5
Tetrachloroethene 1,1,2,2-	5	5
Tetrachloroethylene	5	5
Tetrahydrofuran (THF)	5	5
Toluene	5	5
Trichlorobenzene, 1,2,4-	5	5
Trichlorobenzene, 1,2,3-	5	5
Trichloroethane 1,1,1-	5	5
Trichloroethane 1,1,2-	5	5
Trichloroethylene (TCE)	5	5
Trichlorofluoromethane (Freon 11)	5	5
Trichloropropane, 1,2,3-	5	5
Trimethylbenzene, 1,2,4-	5	5
Trimethylbenzene, 1,3,5-	5	5
Vinyl chloride	2	5
Xylene, o-	5	5
Xylenes, m&p-	5	5
Inorganics		
Antimony	20	1,000
Arsenic	20	1,000
Barium	200	10,000
Beryllium	5	300
Cadmium	5	300
Chromium	20	1,000
Lead	10	500
Mercury	0.2	33

Laboratory Analysis Parameter Table		
Parameter	Quantitation Limit Objective	
	Aqueous ug/L	Soil/Sediment ug/kg
Nickel	50	2,500
Selenium	30	1,500
Silver	10	1,500
Thallium	20	1,000
Vanadium	50	2,500
Zinc	50	2,500
Hexavalent Chromium	NA	4,000
Cyanide	10	1,000
Extractable Petroleum Hydrocarbons (EPH)		
Acenaphthene	5	500
Acenaphthylene	5	500
Anthracene	5	500
Benzo(a)anthracene	5	500
Benzo(a)pyrene	5	500
Benzo(b)fluoranthene	5	500
Benzo(g,h,i)perylene	5	500
Benzo(k)fluoranthene	5	500
C9-C18 Aliphatics	30	3,000
C11-C22 Aromatics	85	8,500
C19-C36 Aliphatics	40	4,000
Chrysene	5	500
Dibenzo(a,h) anthracene	5	500
Fluoranthene	5	500
Fluorene	5	500
Indeno (1,2,3-cd) pyrene	5	500
2-Methylnaphthalene	5	500
Naphthalene	5	500
Phenanthrene	5	500
Pyrene	5	500
Volatile Petroleum Hydrocarbons (VPH)		
C5-C8 Aliphatics	100	5,000
C9-C12 Aliphatics	20	1,000
C9-C10 Aromatics	30	1,500
Benzene	5	250
Ethylbenzene	5	250
Methyl-t-butyl ether	15	250
Naphthalene	10	500
Toluene	15	750
m,p-Xylene	20	1,000
o-Xylene	10	500
Semivolatile Organic Compounds (SVOCs)		
Acenaphthene	10	330
Acenaphthylene	10	330

Laboratory Analysis Parameter Table		
Parameter	Quantitation Limit Objective	
	Aqueous ug/L	Soil/Sediment ug/kg
Acetophenone	10	330
Aniline	10	330
Anthracene	10	330
Azobenzene	10	330
Benzo(a)anthracene	10	330
Benzo(a)pyrene	10	330
Benzo(b)fluoranthene	10	330
Benzo(k)fluoranthene	10	330
Benzo(g,h,i)perylene	10	330
Bromophenyl phenyl ether, 4-	10	330
Butyl benzyl phthalate	10	330
Butyl phthalate, Di-n-	10	330
Bis(2-Chloroethoxy)methane	10	330
Bis(2-Chloroethyl)ether	10	330
Bis(2-Chloroisopropyl)ether	10	330
Chloroaniline, 4-	10	330
Chloronaphthalene, 2-	10	330
Chlorophenol 2-	10	330
Chrysene	10	330
Dibenz(a,h)anthracene	10	330
Dibenzofuran	10	330
Dichlorobenzene, 1,2-	10	330
Dichlorobenzene, 1,3-	10	330
Dichlorobenzene, 1,4-	10	330
Dichlorobenzidine, 3,3' -	10	330
Dichlorophenol 2,4-	10	330
Diethyl phthalate	10	330
Dimethylphthalate	10	330
Dimethylphenol 2,4-	10	330
Dinitrophenol 2,4-	20	670
Dinitrotoluene 2,4-	10	330
Dinitrotoluene 2,6-	10	330
Bis (2-Ethylhexyl) phthalate	10	330
Fluoranthene	10	330
Fluorene	10	330
Hexachlorobenzene	10	330
Hexachlorobutadiene	10	330
Hexachloroethane	10	330
Indeno(1,2,3-cd)pyrene	10	330
Isophorone	10	330
Methylnaphthalene 2-	10	330
Methylphenol, 2-	10	330
Methylphenol, 3 & 4-	10	330

Laboratory Analysis Parameter Table		
Parameter	Quantitation Limit Objective	
	Aqueous ug/L	Soil/Sediment ug/kg
Naphthalene	10	330
Nitrobenzene	10	330
Nitrophenol, 2-	10	330
Nitrophenol 4-	20	670
Octyl phthalate, di-n-	10	330
Pentachlorophenol	20	670
Phenanthrene	10	330
Phenol	10	330
Pyrene	10	330
Trichlorobenzene, 1,2,4-	10	330
Trichlorophenol 2,4,5-	20	670
Trichlorophenol 2,4,6-	10	330
Polychlorinated Biphenyls (PCBs)		
Aroclor 1016	0.2	33
Aroclor 1221	0.2	33
Aroclor 1232	0.2	33
Aroclor 1242	0.2	33
Aroclor 1248	0.2	33
Aroclor 1254	0.2	33
Aroclor 1260	0.2	33

Laboratory Precision/Accuracy Objectives

Parameter	Reference	Accuracy Objectives			Precision Objectives		
Metals	SW -846 Method 6010B/7471A/7470A				Field Duplicates	RPD Water	RPD Soil
					All metals	30	50
		Matrix Spikes	%Rec. Water	%Rec. Soil	Lab Duplicates	RPD Water	RPD Soil
		All metals	75-125	75-125	All metals	20	35
VOCs	SW -846 Method 8260B	Surrogates	%Rec. Water	%Rec. Soil	Field Duplicates	RPD Water	RPD Soil
		Toluene-d8	70-130	70-130	All compounds	30	50
		Bromofluorobenzene	70-130	70-130			
		1,2-Dichloroethane-d4	70-130	70-130			
		Dibromofluoromethane	70-130	70-130			
		Matrix Spikes	%Rec. Water	%Rec. Soil	MS/MSD	RPD Water	RPD Soil
		All target VOCs	70-130	70-130	All target VOCs	20	20
SVOCs	SW -846 Method 8270C	Surrogates	%Rec. Water	%Rec. Soil	Field Duplicates	RPD Water	RPD Soil
		Nitrobenzene-d5	30-130	30-130	All compounds	30	50
		2-Fluorobiphenyl	30-130	30-130			
		p-Terphenyl-d14	30-130	30-130			
		Phenol-d5	15-110	30-130			
		2, 4, 6-Tribromophenol	15-110	30-130			
		2-Fluorophenol	15-110	30-130			
		Matrix Spikes	%Rec. Water	%Rec. Soil	MS/MSD	RPD Water	RPD Soil
		All target base-neutral SVOCs	40-140	40-140	All target base-neutral SVOCs	20	30
		All target acid SVOCs	30-130	30-130	All target acid SVOCs	20	30
PCBs	SW -846 Method 8082	Surrogates	%Rec. Water	%Rec. Soil	Field Duplicates	RPD Water	RPD Soil
		Decachlorobiphenyl	30-150	30-150	All Compounds	30	50
		Tetrachloro -meta-xylene	30-150	30-150			
		Matrix Spikes	%Rec. Water	%Rec. Soil	MS/MSD	RPD Water	RPD Soil
		Aroclor-1260	40-140	40-140	Aroclor-1260	50	50
		Aroclor-1016	40-140	40-140	Aroclor-1016	50	50
Cyanide	SW -846 9010B/9014				Field Duplicates	RPD Water	RPD Soil
					Cyanide	30	50
		Matrix Spikes	%Rec. Water	% Rec. Soil	Lab Duplicates	RPD Water	RPD Soil
		Cyanide	75-125	75-125	Cyanide	20	35

(Laboratory Precision/Accuracy Objectives, continued)

Parameter	Reference	Accuracy Objectives			Precision Objectives		
Hexavalent Chromium	SW -846 3060A/7196A				Field Duplicates	RPD Water	RPD Soil
					Hexavalent chromium	30	50
		Matrix Spikes	%Rec. Water	% Rec. Soil	Lab Duplicates	RPD Water	RPD Soil
		Soluble Cr ⁺⁶ Insoluble Cr ⁺⁶ Trivalent Cr	NA NA NA	75-125 75-125 < 10	Hexavalent Chromium	20	35
EPH	MA DEP Method	Surrogates	%Rec. Water	% Rec. Soil	Field Duplicates	RPD Water	RPD Soil
		1-Chlorooctadecane	40-140	40-140	All compounds	30	50
		2-Bromonaphthalene	40-140	40-140			
		2-Fluorobiphenyl	40-140	40-140			
		o-Terphenyl	40-140	40-140			
		Matrix Spikes	%Rec. Water	% Rec. Soil	Lab Duplicates	RPD Water	RPD Soil
		Acenaphthene	40-140	40-140	All compounds	50	50
		Anthracene	40-140	40-140			
		Chrysene	40-140	40-140			
		C11-C22 Aromatics	40-140	40-140			
		C19-C36 Aliphatics	40-140	40-140			
		C9-C18 Aliphatics	40-140	40-140			
		Naphthalene	40-140	40-140			
		Pyrene	40-140	40-140			
VPH	MA DEP Method	Surrogates	%Rec. Water	% Rec. Soil	Field Duplicates	RPD Water	RPD Soil
		2,5-Dibromotoluene	70-130	70-130		30	50
		4-Bromofluorobenzene	70-130	70-130			
		Matrix Spikes	%Rec. Water	% Rec. Soil	Lab Duplicates	RPD Water	RPD Soil
		Benzene	70-130	70-130	All compounds	50	50
		Ethylbenzene	70-130	70-130			
		m & p-xylene	70-130	70-130			
		Methyl tert butyl ether	70-130	70-130			
		Naphthalene	70-130	70-130			
		O-Xylene	70-130	70-130			
		Toluene	70-130	70-130			
pH	SW -846 9045C				Field Duplicates	RPD Water	RPD Soil
					pH	NA	50
					Lab Duplicates	RPD Water	RPD Soil
					pH	NA	20

(Laboratory Precision/Accuracy Objectives, continued)

Parameter	Reference	Accuracy Objectives	Precision Objectives		
ORP	ASTM D1498-00		Field Duplicates	RPD Water	RPD Soil
			pH	NA	50
			Lab Duplicates	RPD Water	RPD Soil
			pH	NA	20

13.0 APPENDIX M

13.1 Field Quality Control Requirements

QC Sample	Frequency ¹	Acceptance Criteria	Corrective Action
Trip Blank	Daily <u>1 for each shipping container of VOC and VPH samples</u>	No compounds detected	Resample if cross contamination is suspected or qualify data.
Field Duplicate	<u>X</u> 5% per parameter per matrix ³	Per EPA Data validation guidelines for comparison of field duplicates	Compare to appropriate action level (e.g., reportable concentration, Upper Concentration Limit, etc.) and determine need for re-sampling or re-analysis.
Matrix Spike and/or Matrix Spike Duplicates	<u>X</u> 5% per parameter per matrix ³	Per Section 12, Appendix L, for matrix spike recovery and RPD criteria.	Compare to appropriate action level (e.g., reportable concentration, Upper Concentration Limit, etc.) and determine need for re-sampling or re-analysis.
Equipment/Rinsate Blanks	NA	NA	NA

1 – Refer to Tables F-1 and F-2 for exceptions.

2 – Rinsate blanks will not be collected as part of this assessment work based on a general industry trend to place less emphasis on rinsate blanks and more emphasis on the collection and analysis of matrix spike and matrix spike duplicate samples as a quality assurance and quality control measure.

3 – Field Duplicates and MS/MSD samples will not be collected for PCB analysis associated with ground water sampling at the FlynnTan site and soil sampling at the 61 Ward Street site.

NA – Not Applicable.

14.0 APPENDIX N

14.1 Data Management and Documentation

14.1.1 Field Log Book Records

All information pertinent to sampling (including instrument calibration data) will be recorded in a logbook. This book will be bound, preferably with consecutively numbered pages. Entries in the logbook will be made in black ink and will include, at a minimum, a description of all activities, individuals involved (sampling and oversight), date and time of sampling, weather conditions, any problems, and all field measurements.

Sufficient information will be recorded during the sampling trip to permit reconstruction of the sampling without reliance on the collector's memory. Shelf life, lot numbers, manufacturer, and expiration dates of buffer and standard solutions used for calibration of field instrumentation will be recorded.

14.1.2 Laboratory Data Package Deliverables

The data packages from the analytical chemistry laboratories will consist of full deliverables, including all QC and raw data.

15.0 APPENDIX O

15.1 Assessment and Response Actions

The project Quality Assurance Program includes performance audits as independent checks on the quality of data obtained from sampling, analysis, and data gathering activities. Either type of audit may show the need for corrective action.

Performance Audits: The sampling, analysis, and data handling segments of a project are checked in performance audits.

EPA Quality Control Concentrates and NIST Standard Reference Materials will be used to assess the analytical work. The laboratory QC Coordinator will direct the inclusion in the sample load of QC samples appropriate to the analyses performed in each batch of 20 or fewer samples. In addition, any appropriate interlaboratory study samples, which are available during this program, will be analyzed to further audit the analytical work.

Immediate Corrective Action: Corrective action for analytical work will include recalibration of instruments, reanalysis of known QC samples and, if necessary, of actual field samples. Specific QC procedures and checklists will be in use by the analytical laboratory, designed to help analysts detect the need for corrective action. Often the person's experience will be valuable in alerting the operator to suspicious data or malfunctioning equipment.

If an immediate corrective action can be taken, as part of normal operating procedures, the collection of poor quality data can be avoided. Instrument and equipment malfunctions are amenable to this type of action and the QC procedures include troubleshooting guides and corrective action suggestions. The actions taken will be noted in field or laboratory notebooks, but no other formal documentation is required, unless further corrective action is necessary. These on-the-spot corrective actions are an everyday part of the QA/QC system.

Corrective action during the field sampling portion of a program is most often a result of equipment failure or an operator oversight and may require recollection of a sample. Operator oversight is best avoided by having field crew members audit each other's work before and after a test. Every effort will be made by the Field Team Leader to ensure that all QC procedures are followed.

If potential problems are not solved as an immediate corrective action, TRC will apply formalized long-term corrective action if necessary.

Long-Term Corrective Action: The need for long-term corrective action may be identified by standard QC procedures, control charts, performance or system audits. Any quality problem which cannot be solved by immediate corrective action falls into the long-term category. The City of Salem

and its contractor, TRC, will use a system to ensure that the quality problem is reported to a person responsible for correcting it, and who is part of a closed-loop action and follow-up plan.

The essential steps in the closed-loop corrective action system are listed below.

- Identify and define the problem.
- Assign responsibility for investigating the problem.
- Investigate and determine the cause of the problem.
- Determine a corrective action to eliminate the problem.
- Assign and accept responsibility for implementing the corrective action.
- Establish effectiveness of the corrective action and implement it.
- Verify that the corrective action has eliminated the problem.

Documentation of the problem is important to the system. A Corrective Action Request Form will be filled out by the person finding the quality problem. This form identifies the problem, possible causes and the person responsible for action on the problem. The responsible person may be a laboratory analyst, field team leader, laboratory QC coordinator, or the TRC QA Officer. If no person is identified as responsible for the action, the TRC QA Officer investigates the situation and determines who is responsible in each case.

The Corrective Action Request Form includes a description of the corrective action planned and the date it was taken, and space for follow-up. The TRC QA Officer checks to be sure that initial action has been taken and appears effective and, at an appropriate later date, checks again to see if the problem has been fully solved. The TRC QA Officer receives a copy of all Corrective Action Request Forms. This permanent record aids the TRC QA Officer in follow-up and makes any quality problems visible to management; the log may also prove valuable in listing a similar problem and its solution.

16.0 APPENDIX P

16.1 Project Reports

The work conducted for this program will be presented in a Phase II report prepared by TRC containing figures and tables depicting Site conditions, and recommendations for further actions. The text will be supported by exploration logs, analytical data, summary tables, and figures showing exploration locations, ground water contours, and contaminant distribution, as appropriate. The report will include a statement regarding data quality and the impact of data problems on the usability of the data. This will include quality problems found and corrective actions taken.

17.0 APPENDIX Q

17.1 Data Evaluation

a. Data Review Process

Field sampling data will be evaluated by the Field Team Leader and/or the Field QC Coordinator, based on their judgment of the representativeness of the sample, maintenance and cleanliness of sampling equipment, and adherence to the approved, written sample collection procedure.

The following criteria will be used to evaluate the field sampling data:

- Use of approved sampling procedures;
- Use of reagents that have conformed to QC specified criteria; and
- Proper chain-of-custody maintained.

b. Data Validation

TRC will ensure that deliverables from the laboratory will be sufficient for data validation at another date, if needed. The data packages will be reviewed for completeness.

Validation may be performed on the data but will be limited to holding times and QC results, as summarized on forms from the laboratory. Validation actions will be in accordance with the Region I, EPA-New England Data Validation Functional Guidelines for Evaluating Environmental Analyses, dated December 1996. The validation will be performed by TRC, who is a contractor experienced in performing data validation. A memo summarizing the results of the validation will be included in the report.

18.0 APPENDIX R

18.1 Data Usability

Precision: Precision will be determined by the analysis of duplicate samples (laboratory and field) and MS/MSDs and will be expressed as the relative percent difference, (RPD) which is determined according to the following equation:

$$\text{Relative \% difference} = \frac{\text{Value 1} - \text{Value 2}}{\text{Arithmetic Mean of Value 1 and 2}} \times 100$$

Accuracy: Accuracy will be determined from the analysis of surrogate spikes, laboratory control samples and matrix spike samples whose true values are known to the analyst. Accuracy will be expressed as percent recovery. The formulas to calculate these values are:

$$\text{Percent Recovery} = 100 \times \frac{\text{Measured Value}}{\text{True Value}}$$
$$\text{Matrix Spike Percent Recovery} = 100 \times \frac{(\text{Sample conc.} + \text{spike conc.}) - \text{sample conc.}}{\text{spike conc.}}$$

Completeness: Completeness will be reported as the percentage of all measurements made whose results are judged to be valid. The following formula will be used to estimate completeness:

$$C = 100 \frac{V}{T}$$

where:

C = percent completeness

V = number of measurements judged valid

T = total number of measurements

The criteria to be used for evaluating data and determination of outliers are contained in Appendix L of this QAPP.

Discussion: The results of the data usability assessment will be discussed in TRC's project report referenced in Appendix P. This discussion will include an assessment of measurement error with respect to either field sampling or analytical testing activities. This will be accomplished by performing a

cursory scan of critical data quality parameters such as cooler temperature, sample holding times, surrogate recoveries, etc. An opinion statement will be included describing whether identified problems have a major or minor impact on data usability, and whether or not data quality objectives were achieved. A discussion will be included in the final report that will assess precision, accuracy and completeness and how these parameters affect the usability of the data.

ATTACHMENT A

TRC SOPS

ATTACHMENT B

LABORATORY QUALITY ASSURANCE MANUAL